TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: SYL 501

U.S APPLICATION NO. (If known, see 37 CFR 1.5): 09/807573

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR99/02443	12 October 1999	16 October 1998

TITLE OF INVENTION: PHARMACEUTICAL COMPOSITION WITH GASTRIC RESIDENCE AND CONTROLLED RELEASE

APPLICANT(S) FOR DO/EO/US: ALAUX, Gérard; ANDRE, Frédéric; CUINE, Alain; and, LEWIS, Gareth

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND or SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1)).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371 (c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☒ Unexecuted oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. ☒ A FIRST preliminary amendment.

    ☐ A SECOND or SUBSEQUENT preliminary amendment.

14. ☐ A substitute specification.

15. ☐ A change of power of attorney and/or address letter.

16. ☒ Other items or information:
    Citation of References
    Information Disclosure Statement by Applicant (Form PTO-1449)

JC03 Rec'd PCT/PTO 13 APR 2001

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/807573	PCT/FR99/02443	SYL 501

17. ☒ The following fees are submitted:

	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1. 492 (a)(1)-(5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and international Search Report not prepared by the EPO or JPO ....$1000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO...........$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ...$710.00 International preliminary examination fee (37 CFR 1.482)paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) ....$690.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfy provisions of PCT Article 33(1)-(4)...........................$100.000		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	40 -20 =	20	x $18.00	$ 360.00	
Independent claims	1 - 3 =	0	x $80.00	$ 0.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$ 1220.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$ 1220.00	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				$	
TOTAL NATIONAL FEE =				$ 1220.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 1220.00	
				Amount to be refunded:	$
				Charged	**$1220.00**

a. ☐ A check in the amount of $_________________ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 19-0091 in the amount of $1220.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-0091. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Filing under 35 U.S.C. § 371
Corresponding to International
Application Serial No.: PCT/FR99/02443

Applicants: ALAUX, Gérard; ANDRE, Frédéric; CUINE, Alain; and LEWIS, Gareth

International Filing Date: 04 October 1999

For: PHARMACEUTICAL COMPOSITION WITH GASTRIC RESIDENCE AND CONTROLLED RELEASE

CERTIFICATE UNDER 37 C.F.R. 1.10

Express Mail Label Number: EL676471142US

Date of Deposit: April 13, 2001

I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" Service on the date indicated above and is addressed to: Commissioner for Patents, Box PCT, Attn: EO/US, Washington, DC 20231.

Paula S. Ducey

Signature

Commissioner for Patents
Box PCT
Attn: EO/US
Washington, D.C. 20231

Dear Sir:

PRELIMINARY AMENDMENT

Please amend the above-identified application as follows:

In the Claims:

Please amend claims 1-4, 6-9, 11 and 12, cancel claims 5, 10 and 13, and add new claims 14-43 as follows before calculating the filing fee for the above-identified application.

Please amend claims 1-4, 6-9, 11 and 12, to read as follows.

1. (Amended) A controlled-release pharmaceutical composition with gastric residence comprising two or three layers and further comprising:

(a) an active principle combined with an excipient which modifies its release,

(b) a carbon dioxide-generating system in a swelling hydrophilic polymer matrix,

wherein (a) and (b) are included in the same layer [(a)+(b)] or in separate layers [(a)]

and [(b)] and wherein multiple layers containing (a), (b) or (a) and (b) in the same tablet have the same or different compositions and dimensions.

2. (Amended) A composition according to Claim 1 wherein the swelling polymer matrix consists of a hydrophilic polymer chosen from the following families of hydrophilic polymers:

- natural polysaccharides,
- cellulose derivatives,
- polyvinylpyrrolidones,
- polymers derived from acrylic acid and methacrylic acid and salts thereof, or
- aminoacid polymers,

or a mixture of 2 or 3 hydrophilic polymers chosen from the same family.

3. (Amended) A composition according to Claim 2, wherein the hydrophilic polymer is chosen from:

- alginates, xanthan gum, guar gum, gum arabic or carob gum,
- methylhydroxyethylcellulose, carboxymethylcellulose, sodium carboxymethylcellulose, calcium carboxymethylcellulose, hydroxypropylcellulose or hydroxypropylmethylcellulose,
- polyacrylates, or
- polylysines.

4. (Amended) A composition according to Claim 2 further comprising a hydrophilic excipient capable of promoting the hydration of swelling polymer matrices, chosen from lactose, mannitol, sorbitol, microcrystalline cellulose, sodium lauryl sulfate, sodium ricinoleate, sodium tetradecyl sulfate, sodium dioctyl sulfosulfonate, ketomagrocol, poloxamer and polysorbates.

6. (Amended) A composition according to Claim 2 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent chosen from an alkali metal carbonate, an alkaline-earth metal carbonate and an alkali metal bicarbonate.

7. (Amended) A composition according to Claim 6 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent and at least one acidic compound chosen from the group consisting of monocarboxylic acids, polycarboxylic acids and partial salts of polycarboxylic acids.

8. (Amended) A composition according to Claim 7 wherein the acidic

compound is tartaric acid, succinic acid, citric acid or a partial salt thereof.

9. (Amended) A composition according to Claim 2 wherein the active principle is a benzamide.

11. (Amended) A composition according to Claim 2 wherein the active principle is an α_1-antagonist.

12. (Amended) A composition according to Claim 2 wherein the active principle is captopril, furosemide, ursodeoxycholic acid, amoxicillin, (+)-α-aminomethyl-2-methoxy-5-sulfonamidobenzenemethanol or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide, or a salt thereof.

Please cancel claims 5, 10, and 13 without prejudice and add the following new claims.

-- 14. (New) A composition according to Claim 3 further comprising a hydrophilic excipient capable of promoting the hydration of swelling polymer matrices, chosen from lactose, mannitol, sorbitol, microcrystalline cellulose, sodium lauryl sulfate, sodium ricinoleate, sodium tetradecyl sulfate, sodium dioctyl sulfosulfonate, ketomagrocol, poloxamer and polysorbates.

15. (New) A composition according to Claim 2 wherein the excipient which modifies the release of the active principle is a hydrophilic polymer chosen from the following families of hydrophilic polymers:
- natural polysaccharides,
- cellulose derivatives,
- polyvinylpyrrolidones,
- polymers derived from acrylic acid and methacrylic acid and salts thereof, or
- aminoacid polymers,

or a mixture of 2 or 3 hydrophilic polymers chosen from the same family,
or, when (a) and (b) are in separate layers, said excipient may further be a lipid substance chosen from hydrogenated castor oil, beeswax, carnauba wax, glyceryl trimyristate, glyceryl trilaurate, glyceryl tristearate, cetyl palmitate and glyceryl behenate, or a combination of a hydrophilic polymer and a lipid substance.

16. (New) A composition according to Claim 4 wherein the excipient which modifies the release of the active principle is a hydrophilic polymer chosen from the following families of hydrophilic polymers:

- natural polysaccharides,
- cellulose derivatives,
- polyvinylpyrrolidones,
- polymers derived from acrylic acid and methacrylic acid and salts thereof, or
- aminoacid polymers,

or a mixture of 2 or 3 hydrophilic polymers chosen from the same family,
or, when (a) and (b) are in separate layers, said excipient may further be a lipid substance chosen from hydrogenated castor oil, beeswax, carnauba wax, glyceryl trimyristate, glyceryl trilaurate, glyceryl tristearate, cetyl palmitate and glyceryl behenate, or a combination of a hydrophilic polymer and a lipid substance.

17. (New) A composition according to Claim 14 wherein the excipient which modifies the release of the active principle is a hydrophilic polymer chosen from the following families of hydrophilic polymers:

- natural polysaccharides,
- cellulose derivatives,
- polyvinylpyrrolidones,
- polymers derived from acrylic acid and methacrylic acid and salts thereof, or
- aminoacid polymers,

or a mixture of 2 or 3 hydrophilic polymers chosen from the same family,
or, when (a) and (b) are in separate layers, said excipient may further be a lipid substance chosen from hydrogenated castor oil, beeswax, carnauba wax, glyceryl trimyristate, glyceryl trilaurate, glyceryl tristearate, cetyl palmitate and glyceryl behenate, or a combination of a hydrophilic polymer and a lipid substance.

18. (New) A composition according to Claim 15 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent chosen from an alkali metal carbonate or alkaline-earth metal carbonate and an alkali metal bicarbonate.

19. (New) A composition according to Claim 16 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent which may be chosen from an alkali metal carbonate or alkaline-earth metal carbonate and an alkali metal bicarbonate.

20. (New) A composition according to Claim 17 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent

chosen from an alkali metal carbonate or alkaline-earth metal carbonate and an alkali metal bicarbonate.

21. (New) A composition according to Claim 18 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent and at least one acidic compound chosen from the group consisting of monocarboxylic acids, polycarboxylic acids and partial salts of polycarboxylic acids.

22. (New) A composition according to Claim 19 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent and at least one acidic compound chosen from the group consisting of monocarboxylic acids, polycarboxylic acids and partial salts of polycarboxylic acids.

23. (New) A composition according to Claim 20 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent and at least one acidic compound chosen from the group consisting of monocarboxylic acids, polycarboxylic acids and partial salts of polycarboxylic acids.

24. (New) A composition according to Claim 21 wherein the acidic compound is tartaric acid, succinic acid, citric acid or a partial salt thereof.

25. (New) A composition according to Claim 22 wherein the acidic compound is tartaric acid, succinic acid, citric acid or a partial salt thereof.

26. (New) A composition according to Claim 23 wherein the acidic compound is tartaric acid, succinic acid, citric acid or a partial salt thereof.

27. (New) A composition according to Claim 2 wherein the active principle is selected from the group consisting of amisulpride (D)-tartrate, (S)-(-)-amisulpride, (S)-(-)-amisulpride (D)-tartrate, tiapride hydrochloride, alfuzosine hydrochloride and 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide hydrochloride.

28. (New) A composition according to Claim 8 wherein the active principle is a benzamide.

29. (New) A composition according to Claim 8 wherein the active principle is an α_1-antagonist.

30. (New) A composition according to Claim 8 wherein the active principle is captopril, furosemide, ursodeoxycholic acid, amoxicillin, (+)-α-aminomethyl-2-methoxy-5-sulfonamidobenzenemethanol or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide, or a salt thereof.

31. (New) A composition according to Claim 8 wherein the active principle is selected from the group consisting of amisulpride (D)-tartrate, (S)-(-)-amisulpride, (S)-(-)-amisulpride (D)-tartrate, tiapride hydrochloride, alfuzosine hydrochloride and 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide hydrochloride.

32. (New) A composition according to Claim 24 wherein the active principle is a benzamide.

33. (New) A composition according to Claim 24 wherein the active principle is an α_1-antagonist.

34. (New) A composition according to Claim 24 wherein the active principle is captopril, furosemide, ursodeoxycholic acid, amoxicillin, (+)-α-aminomethyl-2-methoxy-5-sulfonamidobenzenemethanol or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide, or a salt thereof.

35. (New) A composition according to Claim 24 wherein the active principle is selected from the group consisting of amisulpride (D)-tartrate, (S)-(-)-amisulpride, (S)-(-)-amisulpride (D)-tartrate, tiapride hydrochloride, alfuzosine hydrochloride and 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide hydrochloride.

36. (New) A composition according to Claim 25 wherein the active principle is a benzamide.

37. (New) A composition according to Claim 25 wherein the active principle is an α_1-antagonist.

38. (New) A composition according to Claim 25 wherein the active principle is captopril, furosemide, ursodeoxycholic acid, amoxicillin, (+)-α-aminomethyl-2-methoxy-5-sulfonamidobenzenemethanol or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide, or a salt thereof.

39. (New) A composition according to Claim 25 wherein the active principle is selected from the group consisting of amisulpride (D)-tartrate, (S)-(-)-amisulpride, (S)-(-)-amisulpride (D)-tartrate, tiapride hydrochloride, alfuzosine hydrochloride and 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide hydrochloride.

40. (New) A composition according to Claim 26 wherein the active principle is a benzamide.

41. (New) A composition according to Claim 26 wherein the active principle is an α_1-antagonist.

42. (New) A composition according to Claim 26 wherein the active principle is captopril, furosemide, ursodeoxycholic acid, amoxicillin, (+)-α-aminomethyl-2-methoxy-5-sulfonamidobenzenemethanol or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide, or a salt thereof.

43. (New) A composition according to Claim 26 wherein the active principle is selected from the group consisting of amisulpride (D)-tartrate, (S)-(-)-amisulpride, (S)-(-)-amisulpride (D)-tartrate, tiapride hydrochloride, alfuzosine hydrochloride and 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide hydrochloride. --

REMARKS

No new matter is added by the amendments of claims 1-4, 6-9, 11 and 12 or by new claims 14-43.

Claims 1-4, 6-9, 11 and 12 are amended to put them in appropriate U.S. claim format, to utilize accepted U.S. claim terminology, to remove potential ambiguities and to eliminate multiple dependencies.

New claim 14 corresponds to original claim 4 written as singly dependent from claim 3.

New claims 15-17 correspond to original claim 5 and are ultimately dependent from certain of the base claim from which original claim 5 depended.

New claims 18-26 correspond to original claims 6-8 and are ultimately dependent from certain of the base claims from which claims 6-8 originally depended.

New claims 28-30, 32-34, 36-38 and 40-42 correspond to original claims 9, 11 and 12 and are ultimately dependent from certain of the base claims from which claims 9, 11 and 12 originally depended.

New claims 27, 31, 35, 39 and 43 are directed to the active ingredients of original claims 10 and 13 and are dependent from certain of the base claims from which claims 10 and 13 ultimately depended.

The application as presently amended contains claims 1-4, 6-9, 11, 12 and 14-43.

Attached hereto is a page entitled "Version With Markings To Show Changes Made" which is a marked-up version of the changes made to the claims by the instant amendment.

Date: April 12, 2001

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In The Claims:

Claims 1-4, 6-9, and 11-12 have been amended as follows:

1. (Amended) ~~Controlled-release~~ A controlled-release pharmaceutical composition with gastric residence~~, characterized in that it comprises~~ comprising two or three layers and ~~in that it comprises~~ further comprising:
(a) an active principle combined with an excipient which modifies its release,
(b) a carbon dioxide-generating system in a swelling hydrophilic polymer matrix,
wherein (a) and (b) ~~possibly being~~ are included in the same layer [(a)+(b)] or in separate layers [(a)] and [(b)] and ~~the redundant~~ wherein multiple layers containing ~~[~~(a)~~]~~, ~~[~~(b)~~]~~ or ~~[~~(a)~~]~~+and ~~[~~(b)~~]~~ in the same tablet ~~possibly having~~ have the same or different compositions and dimensions.

2. (Amended) ~~Composition~~ A composition according to Claim 1~~,~~ ~~characterized in that~~ wherein the swelling polymer matrix consists of a hydrophilic polymer ~~which may be~~ chosen from the following families of hydrophilic polymers:
- natural polysaccharides,
- cellulose derivatives,
- polyvinylpyrrolidones,
- polymers derived from acrylic acid and methacrylic acid and salts thereof, or
- aminoacid polymers,
or ~~from~~ a mixture of 2 or 3 ~~of them,~~ hydrophilic polymers chosen from the same family ~~of hydrophilic polymers~~.

3. (Amended) ~~Composition~~ A composition according to Claim 2, ~~characterized in that~~ wherein the hydrophilic polymers ~~may be~~ is chosen from:
- alginates, xanthan gum, guar gum, gum arabic or carob gum,
- methylhydroxyethylcellulose, carboxymethylcellulose, sodium carboxymethylcellulose ~~or~~, calcium carboxymethylcellulose, hydroxypropylcellulose or hydroxypropylmethylcellulose,

- polyacrylates, or

- polylysines.

4. (Amended) ~~Composition~~ A composition according to ~~any one of Claims 1 to 3, characterized in that it also comprises~~ Claim 2 further comprising a hydrophilic excipient capable of promoting the hydration of swelling polymer matrices, chosen from lactose, mannitol, sorbitol, microcrystalline cellulose, sodium lauryl sulfate, sodium ricinoleate, sodium tetradecyl sulfate, sodium dioctyl sulfosulfonate, ketomagrocol, poloxamer and polysorbates.

6. (Amended) ~~Composition~~ A composition according to ~~any one of Claims 1 to 5, characterized in that~~ Claim 2 wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent ~~which may be~~ chosen from an alkali metal carbonate ~~or~~ , an alkaline-earth metal carbonate~~, such as calcium carbonate,~~ and an alkali metal bicarbonate~~, such as sodium bicarbonate~~.

7. (Amended) ~~Composition~~ A composition according to Claim 6~~, characterized in that~~ wherein the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent and at least one acidic compound chosen from the group consisting of monocarboxylic acids, polycarboxylic acids and partial salts of polycarboxylic acids.

8. (Amended) ~~Composition~~ A composition according to ~~either of Claims 6 and~~ Claim 7~~, characterized in that~~ wherein the acidic compound is tartaric acid, succinic acid, citric acid or a partial salt thereof~~, such as monosodium citrate~~.

9. (Amended) ~~Composition~~ A composition according to ~~any one of Claims 1 to 8, characterized in that~~ Claim 2 wherein the active principle is a benzamide~~, such as metoclopramide, veralipride, alizapride, clebopride, amisulpride, tiapride or sulpiride, in the form of an enantiomer, diastereoisomers or a mixture, in particular a racemic mixture, or a salt thereof~~.

11. (Amended) ~~Composition~~ A composition according to ~~one of Claims 1 to 8, characterized in that~~ Claim 2 wherein the active principle is an α_1-antagonist ~~such as terazosine or alfuzosine in the form of an enantiomer, a diastereoisomer or a mixture, in particular a racemic mixture, or a salt thereof, in particular alfuzosine hydrochloride~~].

12. (Amended) ~~Composition~~ A composition according to ~~one of Claims 1 to 8, characterized in that~~ Claim 2 wherein the active principle is captopril,

furosemide, ursodeoxycholic acid ~~or~~ , amoxicillin, (+)-α-aminomethyl-2-methoxy-5-sulfonamidobenzenemethanol or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide,
or a salt thereof.

Claims 5, 10 and 13 have been cancelled and new claims 14-43 have been added.

CONTROLLED-RELEASE PHARMACEUTICAL COMPOSITION WITH GASTRIC RESIDENCE

The present invention relates to controlled-release pharmaceutical compositions with gastric residence.

Attempts are most frequently made to administer medicinal products orally. However, oral administration is occasionally made difficult when the active principle is of low bioavailability.

The term "bioavailability" means herein the fraction of active principle which is absorbed from its pharmaceutical form and which arrives in the plasma.

Other active principles are absorbed and may thus be administered orally, but their absorption is incomplete and occasionally irregular. Some other active principles are absorbed well from fast-release pharmaceutical forms, the active principle then being released in less than half an hour, but are less well absorbed from sustained-release pharmaceutical forms.

Such a low and irregular bioavailability may be the result of several factors. Among these, mention may be made of low solubility or very slow dissolution of the active principle, chemical or enzymatic degradation of the active principle in the gastrointestinal tract or slow or incomplete absorption of the active principle.

Specifically, a certain number of active

principles, although being sufficiently soluble, are poorly absorbed in the colon or less well absorbed at this level than in the upper sections of the small intestine, namely the duodenum, the jejunum and the ileum.

Furthermore, a sustained-release form is useful for many medicinal products, for example to allow a less frequent administration: once a day instead of twice a day, or twice a day instead of 3 times a day.

When the active principle is absorbed slowly or incompletely in the lower regions of the gastrointestinal tract, it becomes difficult to design a sustained-release form, which should typically release the active principle over 12 to 16 hours. The problem becomes all the more difficult if there is a window of absorption, i.e. if the active principle is absorbed well only in a portion of the gastrointestinal tract. For example, the active principle may be absorbed well only in the duodenum and the jejunum. Specifically, a sustained-release pharmaceutical form requires a release time of at least 8 hours, which is not achieved in the case of an active principle which is absorbed essentially in the upper sections of the small intestine. This is the problem which the Applicant proposes to solve.

The present invention is thus directed toward

slowing down the speed of gastrointestinal transit and thus of increasing the time available for absorption in the upper sections of the small intestine and more specifically the duodenum, the jejunum and the ileum, while at the same time controlling the release profile.

The invention thus consists of a pharmaceutical composition with gastric residence, characterized in that it comprises two or three layers and in that it comprises:

(a) an active principle combined with an excipient which modifies its release,

(b) a carbon dioxide-generating system in a swelling hydrophilic polymer matrix.

The two- or three-layer tablets made from the various combinations of (a) and (b) form part of the invention, (a) and (b) possibly being included in the same layer [(a)+(b)] or in separate layers [(a)] and [(b)]. The redundant layers [(a)], [(b)] or [(a)+(b)] in the same tablet may have different compositions and dimensions.

Compositions which also form part of the invention are compositions with gastric residence containing two or three layers comprising (a) and (b), characterized in that they comprise a soluble and/or erodable layer. The tablet may thus comprise a layer [(a)+(b)] and a soluble and/or erodable layer to give a two-layer tablet, or alternatively a soluble and/or

erodable layer coated with two outer layers [(a)+(b)] to give a three-layer tablet.

This embodiment makes it possible, like all the compositions according to the invention, to obtain a gradual increase in the contact area between the tablet and the liquids contained in the stomach, so as to tend toward a zero-order dissolution profile, that is to say a controlled-release profile.

The compositions according to the invention are characterized in that, on contact with the gastric juices, the layer(s) [(b)] or [(a)+(b)] increase in volume by virtue of the swelling of the hydrophilic polymer matrix and the immediate production of carbon dioxide. In this way, flotation is obtained quickly and the gastric residence time obtained is large.

The pharmaceutical compositions according to the invention may be useful, for example, for benzamides and α_1-antagonists, and also the following active principles: captopril, furosemide, ursodeoxycholic acid, amoxicillin, (+)-α-aminomethyl-2-methoxysulfonamidobenzenemethanol (disclosed in patent application EP 842 148 in Example 3.6) or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethane-sulfonanilide (NS 49).

The benzamides are, in particular, metoclopramide, veralipride, alizapride, clebopride and more particularly amisulpride, tiapride and sulpiride,

and salts thereof.

The α_1-antagonists are, in particular, terazosine and alfuzosine and salts thereof, in particular alfuzosine hydrochloride. They are intended especially for treating benign hypertrophy of the prostate.

Captopril is used in particular for treating hypertension, furosemide is used as a diuretic, amoxicillin and its salts are used as antibiotics, and ursodeoxycholic acid and its salts are used for treating cholelithiasis, liver disorders and syphilis.

For the purposes of the present invention, the various enantiomers or diastereoisomers of the various active principles or families of active principles (benzamides, α_1-antagonists) are also covered, including mixtures thereof, in particular racemic mixtures thereof, and also salts thereof.

Among the active principles that are more particularly suitable for the compositions according to the invention, mention may be made of amisulpride (D)-tartrate, (S)-(-)-amisulpride, (S)-(-)-amisulpride (D)-tartrate, tiapride hydrochloride, alfuzosine hydrochloride and 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide hydrochloride.

Figure 1 shows three embodiments of the invention with various arrangements of (a) and (b).

Figure 2 represents the dissolution profile

of tiapride hydrochloride formulated in a three-layer tablet according to the invention.

The main function of the carbon dioxide-generating system is to form carbon dioxide in the form of bubbles. These bubbles contribute toward rapidly bringing and then maintaining the pharmaceutical composition of the invention at the surface of the liquids contained in the stomach.

A carbon dioxide-generating system which is suitable in a pharmaceutical composition according to the invention generally comprises at least one carbon dioxide-generating agent. The carbon dioxide-generating agent is usually an alkali metal carbonate or an alkaline-earth metal carbonate, such as calcium carbonate, or an alkali metal bicarbonate, preferably sodium bicarbonate.

Such a carbon dioxide-generating system, consisting solely of a carbon dioxide-generating agent, does not begin to form carbon dioxide bubbles until it has been placed in contact with a medium at acidic pH, generally that of the stomach.

In order to accelerate the formation of carbon dioxide bubbles and thus improve the flotation of the pharmaceutical composition with gastric residence of the invention, it is preferred to use a pH-independent carbon dioxide-generating system. Such a system may comprise a carbon dioxide-generating agent

such as those mentioned above, along with at least one acidic compound chosen from the group consisting of monocarboxylic acids such as lactic acid, polycarboxylic acids and partial salts of polycarboxylic acids. Acidic compounds which may be mentioned more particularly include tartaric acid, maleic acid, malonic acid, malic acid, fumaric acid, succinic acid, adipic acid and citric acid and partial salts thereof, such as monosodium citrate.

In such a carbon dioxide-generating system, the content of acidic compound is generally chosen such that the number of moles of the said acidic compound relative to the number of moles of the said carbon dioxide-generating agent is from 0.7 to 1.4 times the stoichiometry.

However, if the active principle or any other component forming part of the formulation of the composition according to the invention is of basic nature, it may be consequently necessary to increase the content of acidic compound.

The hydrophilic polymers which are suitable for forming a swelling hydrophilic polymer matrix may be chosen from:

- natural polysaccharides such as alginates, xanthan gum, guar gum, gum arabic or carob gum,
- semi-synthetic polysaccharides, in particular cellulose derivatives such as methylhydroxyethyl-

cellulose, carboxymethylcellulose and its salts such as sodium carboxymethylcellulose or calcium carboxymethylcellulose, hydroxypropylcellulose or hydroxypropylmethylcellulose, or

- synthetic hydrophilic polymers such as
  - polyvinylpyrrolidones,
  - polymers derived from acrylic acid and methacrylic acid and salts thereof, such as polyacrylates, in particular those sold under the brand name Carbopol®, or
  - aminoacid polymers such as polylysines.

Among the natural polysaccharides that are preferred are alginates and xanthan gum.

Among the semi-synthetic polysaccharides that are preferred are hydroxypropylcellulose and hydroxypropylmethylcellulose.

The swelling hydrophilic polymer matrix may consist of a single hydrophilic polymer mentioned above or a mixture of several of them, chosen from the same family of hydrophilic polymers and preferably up to three of them.

In the context of the present invention, the families of hydrophilic polymers are defined by the following list:

- natural polysaccharides,
- cellulose derivatives,
- polyvinylpyrrolidones,

- polymers derived from acrylic acid and methacrylic acid and salts thereof,
- aminoacid polymers.

Among the mixtures which may be mentioned in particular are mixtures of hydroxypropylcellulose and of hydroxypropylmethylcellulose and mixtures of hydroxypropylmethylcelluloses of different molecular weights.

One mixture which is particularly preferred consists of hydroxypropylmethylcelluloses of different molecular weights.

In order to promote a rapid increase in the volume of the pharmaceutical composition, with the hydrophilic polymers mentioned above, it is possible to use hydrophilic products and/or excipients capable of promoting the hydration of the swelling polymer matrices. Hydrophilic diluents such as lactose, mannitol, sorbitol or microcrystalline cellulose may be used for this purpose. Substances which allow faster wetting of the swelling polymer matrix or matrices may also be introduced, thereby facilitating the interaction between the components of this or these layers and the biological fluids. Examples of such substances are sodium lauryl sulfate, sodium ricinoleate, sodium tetradecylsulfate, sodium dioctyl sulfosulfonate, ketomagrocol, poloxamer, polysorbates or any other pharmacologically acceptable surfactant.

Two cases may be distinguished in the choice of excipients which modify the release of the active principle included in (a):

- When the active principle and the carbon dioxide-generating system are in the same layer [(a)+(b)], the hydrophilic polymer(s) which form(s) the swelling hydrophilic matrix or matrices act(s) as modifiers of the release of the active principle. Consequently, a specific excipient which modifies the release of the active principle is not added to the swelling hydrophilic polymers.

- When the active principle is in a layer [(a)] comprising no (b), the excipients modifying the release of the active principle are either hydrophilic polymers or lipid substances which may form a matrix, or a combination of both.

The hydrophilic polymers which may modify the release of the active principle may be chosen from those listed above as hydrophilic polymers forming a swelling matrix, to which may be added ethylcellulose, methylcellulose and acrylic copolymers among them those sold under the brand name Eudragit®.

The lipid substances may be chosen from hydrogenated castor oil, beeswax, carnauba wax, glyceryl trimyristate, glyceryl trilaurate, glyceryl tristearate, cetyl palmitate and glyceryl behenate.

The soluble and/or erodable material, one

layer of which may consist of [lacuna], may be chosen from: soluble diluents such as lactose, mannitol, sorbitol, xylitol or polyalcohols, occasionally mixed with other hydrophilic diluents such as microcrystalline cellulose. Polymers such as hydroxyethylcellulose, carboxymethylcellulose, alginate, albumin, soluble starch or gelatin may be incorporated into this soluble and/or erodable layer up to a percentage of 25% by weight to control the rate of erosion and/or dissolution.

The technical preparation of the tablets may lead to the introduction:

- of lubricants such as magnesium stearate, sodium stearylfumarate, stearic acid, glyceryl monostearate, polyoxyethylene glycols with a molecular weight of from 400 to 7 000 000, hydrogenated castor oil, glyceryl behenate and mono-, di- or trisubstituted glycerides,
- glidants such as colloidal silica or any other silica, and
- binders, buffers and absorbers, and also any other pharmaceutically acceptable additive.

According to preferred embodiments, the compositions of the invention may take the following different forms:

(1) A two-layer tablet, the first layer comprising the active principle and an excipient which modifies its release, and the second layer comprising a carbon

dioxide generator in a swelling polymer matrix.

This type of tablet is represented in Figure 1(i).

(2) A three-layer tablet, the first layer comprising the active principle and an excipient which modifies its release, and the two outer layers comprising a carbon dioxide generator in a swelling polymer matrix. The composition and size of the two outer layers may be identical or different.

This type of tablet is represented in Figure 1(ii).

(3) A three-layer tablet, the outer layers comprising the active principle combined with an excipient which modifies its release and a carbon dioxide generator, the whole in a swelling polymer matrix, and the inner layer consisting of a soluble and/or erodable material and optionally of a carbon dioxide generator. The composition and size of the two outer layers may be identical or different.

This type of tablet is represented in Figure 1(iii).

The tablets of the invention may be produced in the following way: powders and/or granules are mixed together using the current production techniques, and thus with a production process which may be immediately transferred to the industrial scale.

The two-layer or three-layer pharmaceutical

tablet is obtained according to tableting processes that are widely used by and known to those skilled in the art.

For example, the tablets may be produced using rotary presses capable of producing "multi-layer" tablets.

Normally, the working tableting force ranges from 7 to 50 kN (or kilonewtons) and two-layer or three-layer tablets are obtained in cylindrical, lenticular, spheroidal or ovoidal shape, making them easy to administer and swallow.

Depending on the amount of active principle which is conveyed, each layer of the tablet may have a different thickness ranging from 0.2 mm to 8 mm, but preferably from 1 mm to 4 mm.

A coating made of polymer materials may also be applied to the pharmaceutical composition for the purpose of providing a simple protection of the pharmaceutical composition. In this case, the coating should be soluble in acid and neutral solution.

The coating may be applied by conventional methods known to those skilled in the art, using organic or aqueous solutions.

The contents of the various compounds constituting a pharmaceutical composition according to the invention are generally chosen such that the relative density of this composition in the stomach is

less than 1.00.

A pharmaceutical composition according to the invention usually comprises from 0.5% to 70% and preferably from 2% to 60% by weight of active principle, from 10% to 80% and preferably from 15% to 60% by weight of excipient which modifies the release of the active principle, from 10% to 75% and preferably from 15% to 60% by weight of at least one hydrophilic polymer and from 2.5% to 50% and preferably from 10% to 40% by weight of carbon dioxide-generating agent, the percentages being expressed relative to the total weight of the said composition.

The examples which follow illustrate the present invention.

Example 1: Sustained-release floating tablet containing 3 layers of tiapride hydrochloride

Two granules are prepared. For granule 1, Methocel® K100M, Avicel® PH102 and tartaric acid are dry-mixed and then granulated with water in a granulating blender and the granules obtained are then dried. The other components, magnesium stearate, Aerosil® 200 and monosodium carbonate are then dry-added and mixed. For granule 2, tiapride hydrochloride, Methocel® and Avicel® are dry-mixed and are then granulated with water in a granulating blender and the granules obtained are then dried. Magnesium

stearate and Aerosil® are dry-added and mixed. 3-layer tablets are prepared, containing 250 mg of granule 1 in the first outer layer, 280 mg of granule 2 in the inner layer, which contains 100 mg of base tiapride in hydrochloride form, and 200 mg of granule 1 in the second outer layer.

Granule 1: outer layers 1 and 3

Methocel® K100M[1]	45.6%
Avicel® PH102[2]	15.3%
Tartaric acid	17.9%
Monosodium carbonate	20.0%
Magnesium stearate	1.0%
Aerosil® 200[3]	0.2%
	100.0%

Granule 2: inner layer 2

Tiapride hydrochloride	39.6%
Methocel® K100M	41.6%
Avicel® PH101	17.6%
Aerosil® 200	0.2%
Magnesium stearate	1.0%
	100.0%

[1] hydroxypropylmethylcellulose sold by Dow Chemical Co.

[2] microcrystalline cellulose sold by Edward Mendell Co.

[3] colloidal silica sold by the company Degussa

The *in vitro* dissolution is tested according to the following method:

The vane machine described by the European

Pharmacopea is used. The stirring speed is 200 rpm. The UV absorbance is read continuously, by means of withdrawal using a peristaltic pump. The percentage of dissolved tiapride is determined as a function of time, by comparing the UV absorbance at 288 nm of the sample with that of a tiapride hydrochloride standard with a concentration of 0.222 mg/ml in the dissolution medium. The dissolution medium consists of 1 000 ml of 0.01 M hydrochloric acid. The results are given in Figure 2.

A controlled release of the tiapride hydrochloride is obtained.

Example 2: Sustained-release floating 3-layer tablet of NS 49 in hydrochloride form

2 granules are prepared. Granule 1 is identical to that of the above example. Granule 2 is as described below. Three-layer tablets are prepared, containing 150 mg of granule 1 in the first outer layer, 100 mg of granule 2 in the inner layer, which contains 2 mg of NS 49 in hydrochloride form, and 100 mg of granule 1 in the 2nd outer layer.

Granule 2: inner layer 2

NS 49 hydrochloride	2.0%
Methocel® K100M	45.0%
Avicel® PH101	51.8%
Aerosil® 200	0.2%
Magnesium stearate	1.0%
	100.0%

Claims

1. Controlled-release pharmaceutical composition with gastric residence, characterized in that it comprises two or three layers and in that it comprises:

(a) an active principle combined with an excipient which modifies its release,

(b) a carbon dioxide-generating system in a swelling hydrophilic polymer matrix,

(a) and (b) possibly being included in the same layer [(a)+(b)] or in separate layers [(a)] and [(b)] and the redundant layers [(a)], [(b)] or [(a)+(b)] in the same tablet possibly having different compositions and dimensions.

2. Composition according to Claim 1, characterized in that the swelling polymer matrix consists of a hydrophilic polymer which may be chosen from the following families of hydrophilic polymers:

- natural polysaccharides,
- cellulose derivatives,
- polyvinylpyrrolidones,
- polymers derived from acrylic acid and methacrylic acid and salts thereof,
- aminoacid polymers,

or from a mixture of 2 or 3 of them, chosen from the same family of hydrophilic polymers.

3. Composition according to Claim 2,

characterized in that the hydrophilic polymers may be chosen from:

- alginates, xanthan gum, guar gum, gum arabic or carob gum,
- methylhydroxyethylcellulose, carboxymethylcellulose, sodium carboxymethylcellulose or calcium carboxymethylcellulose, hydroxypropylcellulose or hydroxypropylmethylcellulose,
- polyacrylates, or
- polylysines.

4. Composition according to any one of Claims 1 to 3, characterized in that it also comprises a hydrophilic excipient capable of promoting the hydration of swelling polymer matrices, chosen from lactose, mannitol, sorbitol, microcrystalline cellulose, sodium lauryl sulfate, sodium ricinoleate, sodium tetradecyl sulfate, sodium dioctyl sulfosulfonate, ketomagrocol, poloxamer and polysorbates.

5. Composition according to any one of Claims 1 to 4, characterized in that the excipient which modifies the release of the active principle may be chosen from the hydrophilic polymers according to Claim 2 or 3 or from ethylcellulose, methylcellulose and acrylic copolymers,
and also, when (a) and (b), as defined in Claim 1, are in separate layers, also from lipid substances such as

hydrogenated castor oil, beeswax, carnauba wax, glyceryl trimyristate, glyceryl trilaurate, glyceryl tristearate, cetyl palmitate and glyceryl behenate, or a combination of a hydrophilic polymer and a lipid substance.

6. Composition according to any one of Claims 1 to 5, characterized in that the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent which may be chosen from an alkali metal carbonate or alkaline-earth metal carbonate, such as calcium carbonate, and an alkali metal bicarbonate, such as sodium bicarbonate.

7. Composition according to Claim 6, characterized in that the carbon dioxide-generating system comprises at least one carbon dioxide-generating agent and at least one acidic compound chosen from the group consisting of monocarboxylic acids, polycarboxylic acids and partial salts of polycarboxylic acids.

8. Composition according to either of Claims 6 and 7, characterized in that the acidic compound is tartaric acid, succinic acid, citric acid or a partial salt thereof, such as monosodium citrate.

9. Composition according to any one of Claims 1 to 8, characterized in that the active principle is a benzamide, such as metoclopramide, veralipride, alizapride, clebopride, amisulpride,

tiapride or sulpiride, in the form of an enantiomer, diastereoisomers or a mixture, in particular a racemic mixture, or a salt thereof.

10. Composition according to Claim 9, characterized in that the benzamide is amisulpride (D)-tartrate, (S)-(-)-amisulpride, (S)-(-)-amisulpride (D)-tartrate or tiapride hydrochloride.

11. Composition according to one of Claims 1 to 8, characterized in that the active principle is an α_1-antagonist such as terazosine or alfuzosine in the form of an enantiomer, a diastereoisomer or a mixture, in particular a racemic mixture, or a salt thereof, in particular alfuzosine hydrochloride.

12. Composition according to one of Claims 1 to 8, characterized in that the active principle is captopril, furosemide, ursodeoxycholic acid or amoxicillin, (+)-α-aminomethyl-2-methoxy-5-sulfonamidobenzenemethanol or 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethanesulfonanilide, or a salt thereof.

13. Composition according to Claim 12, characterized in that the active principle is 3'-(2-amino-1-hydroxyethyl)-4'-fluoromethane-sulfonanilide hydrochloride.

Figure 1

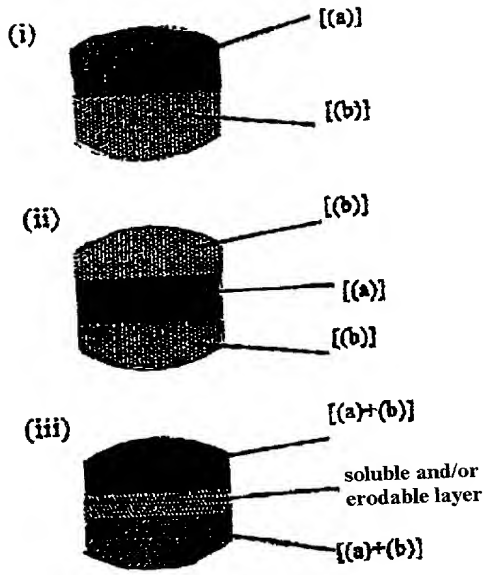
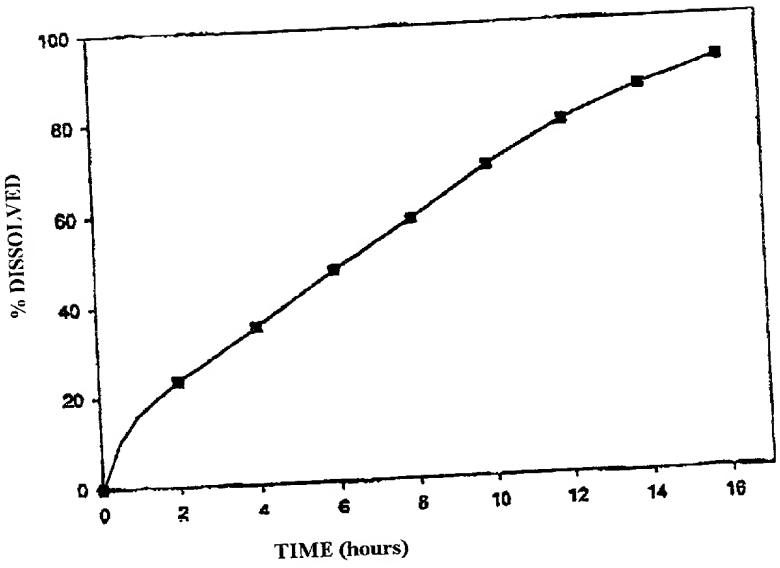


Figure 2



DECLARATION AND POWER OF ATTORNEY FOR UNITED STATES PATENT APPLICATION

__X__ Original _____ Supplemental _____ Substitute

As a below-named inventor, I hereby declare that:

My residence, citizenship and post office address are given below under my name.

I believe I am an original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PHARMACEUTICAL COMPOSITION WITH RESIDENCE AND CONTROLLED RELEASE
the specification of which

____ is attached hereto.

____ was filed on _____ as United States
Application Serial No. _____
And was amended on _____ (if applicable).

__X__ was filed on 12 October 1999 as PCT International
Application No. PCT/FR99/02443
and was amended under PCT Article 19 on _____ (if applicable).

I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge my duty to disclose information of which I am aware which is material to the examination of this application in accordance with Section 1.56 of Title 37 of the Code of Federal Regulations.

I hereby claim foreign priority benefit under Section 119 (a) - (d) of Title 35 of the United States Code of any foreign application(s) for patent or inventor's certificate or of any PCT application(s) designating at least one country other than the United States identified below and also identify below any foreign application(s) for patent or inventor's certificate or any PCT application(s) designating at least one country other than the United States filed by me on the same subject matter and having a filing date before that of the application(s) from which priority is claimed:

			Priority Claimed	
Country	Number	Filing Date	Yes	No
FRANCE	98 12977	16 October 1998	X	

I hereby claim benefit under Section 120 of Title 35 of the United States Code of any United States application(s) or PCT application(s) designating the United States identified below and, insofar as the subject matter of each of the claims of this application is not disclosed in said prior application(s) in the manner provided by the first paragraph of Section 112 of Title 35 of the United States Code, I acknowledge my duty to disclose material information of which I am aware as defined in Section 1.56 of Title 37 of the Code of Federal Regulations which occurred between the filing date of the prior application(s) and the national or PCT filing date of this application:

Application Serial No.	Filing Date	Status

I hereby appoint Michael D. Alexander, Reg. No. 36,080; and Paul E. Dupont, Reg. No. 27,438, or any of them my attorneys or agents with full power of substitution and revocation to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

I hereby declare that all statements made herein and in the above-identified specification of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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